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Collecting *Aphelinus* spp. (Hymenoptera: Aphelinidae) in Southwestern CIS for "Pre-emptive" Biological Control of *Diuraphis noxia* (Homoptera: Aphididae) in Australia

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Abstract.— Surveys of wheat and barley fields were conducted in 1989 and 1990 in parts of Ukraine, southern Russia, and Georgia (CIS), aimed at discovering *Aphelinus* spp. parasitoids of *Diuraphis noxia*. Enough mummies could be collected and shipped in both years to allow for the entomophage to be mass-reared and field-released in Australia as part of a "pre-emptive" integrated control program, i.e. before this aphid has even reached the continent.

Over the last decade, the Russian wheat aphid (RWA), *Diuraphis noxia* Mordwilko (Homoptera : Aphididae) has become a major pest of wheat and barley in southern Africa and North America (Evans et al. 1989). Australia is now the main grain exporting country without RWA, and Hughes and Maywald (1990) have demonstrated that its accidental introduction would result in severe losses to cereal crops over a large proportion of the Australian wheat and barley growing area. To minimize the likely economic consequences of RWA introduction into Australia, a national management plan has been developed to coordinate responses to the pest's arrival. This attempt represents the first concerted program of "pre-emptive" integrated control (Evans et al. 1989) against an arthropod pest. It involves in particular research in biological control, determination of the adequate use of insecticides, as well as a comprehensive screening and breeding program for host plant tolerance or resistance (Martinelle et al. in press a; b).

The classical component of the plan aimed at selecting species of natural enemies of *D. noxia* for introduction into Australia based on the following criteria : (1) ability to attack the host aphid in its cryptic feeding niche ; (2) aptitude to complete development on some of the exotic grass aphid species that are already distributed in the Australian agroecosystems ; (3) faculty to survive under extreme climatic conditions equivalent to those of the Australian wheat belt.

Among the various parasitoid species recorded from cereal aphids (cf. Stary 1981 for instance), and in particular from RWA, representatives of the genus *Aphelinus* Dalman (Hymenoptera: Aphelinidae) fulfill the three above requirements. According to Z.L. Berest (pers. comm.) chalcids only are capable to efficiently attack RWA colonies developing in rolled leaves of cereal plants. Also *Aphelinus* spp. have been reported during 1976-79 as the most important entomophages of *D. noxia* close to its probable centre of origin (Berest 1980). As a consequence, a search for suitable *Aphelinus* spp. and the screening for wheat and barley cultivars showing signs of resistance to various biotypes of RWA were undertaken simultaneously from 1989 on by the Montpellier (France) Biological Control Unit of CSIRO's Division of Entomology. This paper summarizes results obtained in relation with the first aspect of this research program only, i.e. with its component of classical biological control.

SURVEY AND COLLECTION

Numerous wheat and barley fields were visited in May-June 1989, and again during the same period of 1990. These were situated in the Ukraine (along a transect Uzhgorod-Kiev-Odessa, and along the Black Sea coast), southern Russia (Cherkessk-Nalcik-Budennovsk, north of the Caucasus), and Georgia (Abkhazia, south of the Caucasus). The various techniques used for assessing the aphid populations and the impact of their natural enemies, as well as the materials used for preparing and shipping mummies of the selected ento-

mophagous species were as described in detail by Aeschlimann and Vitou (1985).

Throughout the whole area of investigation aphid numbers on average rarely exceeded 1 individual per stem, RWA being almost absent from both cultivated and volunteer species of Gramineae in 1989 and 1990, from sea level to over 2000 m altitude. A totally different situation, however, was observed in experimental gardens where the regional or national Plant Breeding Institutes maintained their collections of cultivars and local accessions. These were usually planted several weeks later than regular crops nearby, and scientists in charge of the station tried to avoid any applications of pesticides. Under those circumstances, spring barley and, to a lesser extent spring wheat harboured very dense aphid infestations (often several hundred individuals per stem), which apart from *D. noxia* comprised large proportions of *Rhopalosiphum padi* Linnaeus, *Schizaphis graminum* Rondani, and *Sitobion avenae* Fabricius (Homoptera: Aphididae). During the 1989 and 1990 visits, 10.9 % of the colonies on average were RWA alone, and 81.4 % mixed populations of two or more aphid species in the Odessa district (Ukraine). Also, it is worth emphasizing that *D. noxia* colonies comprised more individuals and occurred in higher numbers per plant at plots located at the edge of the fields as compared with those situated in the centre of the garden. The highest RWA infestations were observed at spring barley plots adjacent to uncultivated land in which volunteer representatives of *Aegilops* Linnaeus were found at low density, suggesting a possible association with this genus, closely related genetically to *Triticum* Linnaeus.

In the experimental fields of the All-Union Institute for Plant Breeding and Genetics at Odessa, the absolute numbers of aphid mummies recorded per sampling day were similar to that of cadavers showing signs of infection by Entomophthoralean fungi (Zygomycetes : Entomophthorales). Each of those two categories (parasitized and infected aphids) represented an estimated 5 % of the total number of live aphids occurring on the host plants on average of both sampling periods. The overall frequency distribution of natural enemies (relative importance in Table 1) was based on the total number of mummies recorded during the whole collecting time. Results for the various species of the genera *Aphelinus* and *Aphidius* are therefore pooled in Table 1 below, as no distinction could be made between mummies of the different species of each of those two genera. Adult parasitoids emerging "en route" (cf Aeschlimann and Vitou 1985) were identified by P. Stary (Aphidiidae) and M. Carver (Aphelinidae), voucher specimens being kept at CSIRO Montpellier (first author) and CSIRO Canberra (M. Carver).

Table 1. Relative importance of the entomophagous species of *Diuraphis noxia* in southwestern CIS, 1989-90.

Parasitoid species (1)	Relative importance within the parasitic complex (%)
1. Hymenoptera: Aphelinidae	0.5
Aphelinus ? asychis Walker	
Aphelinus varipes Foerster	
2. Hymenoptera: Aphidiidae	44.8
Aphidius ervi Haliday	
Aphidius matricariae Haliday	
Aphidius rhopalosiphi De Stefani-Perez	
Aphidius uzbbekistanicus Luzhetzki	
Diaeretiella rapae M'Intosh	2.0
Ephedrus plagiator Nees	0.2
Praon volucre Haliday	52.5

(1) Importance assessed in terms of numbers of mummies, i.e. to generic level only.

As Table 1 clearly indicates, *Aphelinus* spp. appeared to have less impact on RWA populations developing in island-type situations than under outbreak conditions (cf. Berest 1980). As a consequence, some 25 hours field work were necessary on total each year to obtain enough viable mummies of the chalcid parasitoids to successfully initiate a mass-production in Australia. Both in 1989 and 1990, starter cultures were hand-carried from the Odessa sites and safely forwarded from Montpellier (France) to CSIRO quarantine facilities at Canberra (Australia) in less than 5 days. After the prescribed quarantine propagation, *Aphelinus varipes* Foerster was released as from the second half of 1990 in south-east Australia, where first signs of establishment have been observed and its dispersal and incidence in the fields are being monitored (R.D. Hughes and L.T. Woolcock pers. comm.).

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RESUME

Récoltes de parasitoides de *Diuraphis noxia* (Homoptera : Aphididae) dans le sud-ouest de la CEi, dans le cadre d'un programme de lutte biologique "préventive" en Australie.

Au cours de prospections sur cultures de blé et d'orge menées en Ukraine, Russie méridionale et Géorgie (CEi), des momies d'*Aphelinus* spp. (Hymenoptera : Aphelinidae) ont pu être récoltées et envoyées en nombre suffisant pour constituer un élevage aux fins de libération en Australie. On décrit ici le premier exemple de protection intégrée "préventive", c'est à dire dirigée contre un arthropode nuisible avant même qu'il n'ait envahi une aire biogéographique.

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